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Portraits of botanists.—In 1903 WITTROCK published a set of photographs of botanists selected from the collection at the botanical garden at Stockholm. A second series has now been issued,[11] containing full-page portraits of 100 botanists arranged chronologically from Aristotle to Goebel; and 51 additional plates, each containing 6 portraits. The biographic notes contain a large amount of information which must have been brought together with great labor.—J. M. C.

British Desmidiaceae.—In 1904 the first volume of this work was issued as a publication of the Ray Society. The second volume has now appeared,[12] containing the genera Euastrum (46), Micrasterias (18), and Cosmarium (50). —J. M. C.

NOTES FOR STUDENTS.

Regeneration.—The number of recent papers dealing with regeneration indicates a marked activity in this field of investigation. The work of IRMISCH and others has made us familiar with the fact that the hypocotyls of a number of plants can produce adventitious buds. In some cases these occur normally, but in others only in the presence of more unusual conditions of growth. BURNS and HEDDEN[13] have investigated these conditions, using seedlings of *Linaria bipartita splendida*, *Antirrhinum majus*, and *Linum usitatissimum*. They confirm KÜSTER's results that when the cotyledon or the main vegetative tip is cut away the tendency toward the development of adventitious buds is greatly increased. On uninjured seedlings of Antirrhinum which do not stand erect but are horizontal, buds arise only on the upper side, and when these plants are fastened so that they must remain erect they produce no buds. The effect of a moist atmosphere is to increase the number of buds and the rapidity of their development. The same is true of higher temperature. The older parts of the hypocotyl have a much greater capacity to produce buds than the younger parts, and there is no tendency at all to bud production on the part of the hypocotyl still elongating. Gravity seems to have no influence. Light, on the other hand, is a necessary condition, for in one-sided illumination buds appear only on the illuminated side, on a klinostat in the light on all sides equally, and in the dark not at all. Experiments are mentioned which indicate that wounding is not a cause of the regeneration here. The explanation of the phenomena mentioned as given by the authors is that "when the cotyledons are removed

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[11] WITTROCK, VEIT BRECHER, Catalogus illustratus iconothecae botanicae horti Bergiani Stockholmiensis; notulis biographicis adjectis. Acta Hort. Berg. 3:No.3. pp. xciii+245. *pls. 151.* 1905.

[12] WEST, W., and G. S., A monograph of the British Desmidiaceae. Vol. II. pp. x+206. *pls. 32.* London: Ray Society. 1905.

[13] BURNS, GEORGE P., and HEDDEN, MARY E., Conditions influencing regeneration of the hypocotyl. Beih. Bot. Centralb. 19:383–397. 1906.

or cease to function, their work is taken up by the epidermis. The cells of this develop a vast amount of chlorophyll and all movement is to and from them." "Only those cells exposed to light function as cotyledons, and hence all flow of material is to and from the lightest side. Light is then an indirect cause of the location of the buds, while the principal factor is determining the location in relation to movements of food materials in plants." This would make it entirely a question of nutrition, a rather unusual condition, for in most cases of regeneration in plants, and in animals too, regeneration will occur while the parts concerned are but poorly nourished.

FIGDOR[14] cut off the apices of young fern fronds prependicular to the median axis and very close to the tip, removing only a fraction of a millimeter of the tip. Replacement occurs slowly, but the new tips become forked, two apical cells forming, one on each side of the midrib. The two sides extend outwards, leaving the midrib sunken in the center. By cutting very young fronds with a median longitudinal cut about 5^{mm} deep, regeneration of each half occurs, and a subsequent branching of the frond is obtained. The fern used was *Scolopendrium Scolopendrium*, a variety of which (*daedalea*) occasionally occurs in nature with forked fronds, and FIGDOR considers this probably due to wounding of the tips by insects and subsequent regeneration.

HILDEBRAND[15] has continued his studies on regeneration in Cyclamen, and presents further interesting observations. Two forms are mentioned, *Cyclamen Miliarakisii* and *C. creticum*. On the former, when the leaf blade of the cotyledon is removed, leaving the petiole, there arise a little below the place of removal, from a point on one side of the petiole, four small leaves, each having the form of the cotyledon, and the four together aggregating the size of the blade removed. Each is borne on a distinct petiole of sufficient length to bring the blades out far enough to prevent shading each other. In this the author sees an exceptional example of the principle of utility in the development of plant structures. In the other species, *C. creticum*, HILDEBRAND observed a plant having no cotyledons, but upon which, arising from the center of the tuber, were three leaves with long petioles. Each blade was almost one-third the size of the round cotyledon-blade, and in form intermediate between the cotyledon and the foliage leaves. Investigation showed that the cotyledon had been destroyed to the base, and these three leaves arose together from the axis of the plant just below the point of attachment of the cotyledon. They originated as entirely new structures, replacing cotyledons, and were intermediate in form between these and the later leaves.

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[14] FIGDOR, W., Ueber Regeneration der Blattspreite bei *Scolopendrium Scolopendrium*. Ber. Deutsch. Bot. Gesell. **24**:13–16. 1906.

[15] HILDEBRAND, FRIEDRICH, Ueber eine eigentümliche Ersatzbildung an einem Keimling von *Cyclamen Miliarakisii* und einem anderen von *Cyclamen creticum*. Ber. Deutsch. Bot. Gesell. **24**:39–43. 1906.

SETCHELL[16] gives an account of regeneration among kelps. He distinguishes between physiological and restorative regeneration, applying the terms in the same sense as used by MORGAN. In physiological regeneration he notes two kinds, continuous and periodic. In the former the continuous growth of the meristematic tissue at the base of the blade keeps pace with the constant breaking off at the tip due to wave action, and so the blade retains a constant length. In other species this growth is periodic, occurring in the spring and in the autumn. The growth of a new blade lifts the old one from the top of the stipe and it is rapidly eroded, the new one thus taking its place. Restorative regeneration involves the development of new branches and occurs as a result of wounding. If the stipe is broken off a new blade is formed at its apex. Wounds along the surface of the stipe result in new blades arising at the points. A vertical wound at the tip results in a splitting of the blade and the appearance of forking. The observations are followed by a discussion in which the author contends that the phenomena of regeneration are to be explained best by the assumption of a flow of materials toward the parts concerned. He does not consider it necessary to assume a special organ-forming material, the important thing being the control of the flow of already organized food materials. This control of the food substances is due to certain cells being able to exert a stronger "pull" upon them than others.

As this idea is so commonly used in explanation of regeneration, the reviewer cannot forbear remarking that it removes one difficulty only to incur a greater one. Soluble food materials, in common with all other diffusible solutions in plants, move toward the region of least concentration, and if there is a more rapid flow of substances toward any region, it indicates that these are being taken out of solution there, either by being used or otherwise transformed. The more active the use, the lower will be the concentration, and the more active the flow will tend to be toward that point. The increased activity of the cells, either in using up by growth or otherwise transforming the food substances, must precede any special flow (that is, apart from a general diffusion in all directions) of these substances into any particular region. The movement, or, if preferred, the "flow" of soluble substances (other than a general diffusion) toward special cells is necessarily a result and not the cause of their activity.

MIEHE[17] has used an interesting method of studying the behavior of isolated cells, especially in their relation to polarity. When a tissue is plasmolyzed, the continuity of the protoplasm is broken and the protoplasts become separated from one another. In this way a plant may be divided into its individual cells, and the behavior of these, each acting independently, can be studied. MIEHE used this method on a marine Cladophora. The plants were plasmolyzed in

16 SETCHELL, WILLIAM ALBERT, Regeneration among kelps. Univ. Calif. Publ. Bot. **2**:139–168. *pls. 15–17.* 1905.

17 MIEHE, HUGO, Wachstum, Regeneration und Polarität isolierter Zellen. Ber. Deutsch. Bot. Gesell. **23**:257–264. *pl. 4.* 1905.

a strong salt solution (16.2%), and then transferred gradually to normal sea water. In nearly all cases the protoplasts regained almost entirely their original size, a few remaining in the plasmolyzed form. An active growth promptly set in, by which the form of the alga was entirely changed. First the protoplasm of the last-mentioned cells, by means of rounded or tube-like outgrowth, finally filled up the original space within the cell walls. Then all the cells grew in this way: the basal end of the cell pushed into the cell below in the form of tubes, often growing between the protoplasm and the cell wall; or occasionally the whole cell bulged into its neighbor. When one cell is dead, the next above grows in and fills it completely. Often from the lower angles of the cells tubes grow downward into the cells below. Many of these tubes assume the character of rhizoids. All of these outgrowths occurred at the basal end of the cell, not a single one from the apical end. Later, unless the upper cells begin to produce branches, they do so entirely from the apical end. A very striking polarity of the cell is thus seen.

Some interesting results on polarity and organ-formation on *Caulerpa prolifera* have been contributed by JANSE.[18] This plant he shows to possess a well-marked polarity in the formation of "leaves" and rhizoids, and also in the streaming of the protoplasm, which is always from the apex toward the base. Following a wound there appears to be a division in the protoplasm, the chlorophyll-bearing portion separating from a colorless turbid portion. It is the latter, according to JANSE, that occasions the formation of new organs. The polar phenomena he considers dependent upon a flow of energy in which the force acts always in the direction of the base. This stream of energy he calls the "basipetal impulse." The opposite, an acropetal impulse, was not to be detected, and JANSE concludes that "the lack of an 'acropetal impulse, implies the lack of a second pole at the organic tip." Thus we have a polarity with only one pole. The author applies this conception to polarity as seen in the higher plants. The point of view is more interesting than convincing.

TOBLER[19] uses some observations on Polysiphonia and Ceramium as the basis of a lengthy and rather elusive discussion on regeneration and polarity. He sees a difference in the lower and higher plants in respect to polarity, which he considers rests on the differentiation of tissues, and accompanies the division of labor in the plant.—W. B. MACCALLUM.

Roots of Monocotyledons.—LINDLINGER[20] has reopened the question of the place of origin of the secondary growth shown by the roots of some mono-

[18] JANSE, M. J., Polarität und Organbildung bei *Caulerpa prolifera*. Jahrb. Wiss. Bot. **42**:394–460. *pls. 9–11*. 1906.

[19] TOBLER, FR., Ueber Regeneration und Polarität sowie verwandte Wachstumsvorgänge bei Polysiphonia und andern Algen. Jahrb. Wiss. Bot. **42**:461–502. *pls. 12–14*. 1906.

[20] LINDLINGER, L., Zur Anatomie und Biologie der Monocotylenwurzeln. Beih. Bot. Cent. **19**:321–358. 1905.